FORAGE EXPEDITION TO EUROPE - 1956

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Members of the Plant Introduction Section's forage expedition to Europe in 1956 were Howard Scott Gentry, botanist, and Harry A. Schoth, agronomist. The party left Washington by plane May 21 and landed in Rome the following day. They returned September 19-20 by plane from Paris. During the four months their contacts and travels took them through Italy, Spain, Switzerland, France, Germany, Belgium, Holland, Denmark, and Sweden.

The objectives of the expedition were defined largely through a proposal presented by the Northeastern Regional Technical Committee, NE-9, under date of November 1, 1954. This request specified seven grass and legume species of primary concern to forage specialists of the northeastern region of the United States, and included Arrhenatherum elatius, Festuca elatior, Lotus uliginosus, Phalaris arundinacea, Phalaris tuberosa, Trifolium repens and Trifolium pratense. In addition there were numerous requests and suggestions from the Forage and Range Section at Beltsville, state experiment station research personnel and others, for certain specialities such as information on European cultures of hazel nuts (filberts). The Plant Introduction Section realized that the procurement of these research materials presented an opportunity to become more familiar with the methods and latest results of the European plant breeding station, and opportunities to make arrangements for exchange of seed and other propagating materials for research.

Coincident with the procurement of forage selections, the field party visited most of the principal forage research stations in the countries already mentioned. Two classes of seeds were sought: (1) the cultivated strains of breeder's selections or stocks, and (2) the seeds of wild or spontaneous populations of pastures and countryside. The stations visited, field collection areas worked over and the materials obtained are summarized below.

The Forage Stations Visited

Italy

Our first contact in Italy was with Mr. R. O. Whyte, United Nations' FAO, Rome. Under his direction the Agricultural Division has been active in plant introduction work during the past several years. Members of the staff contributed information and guidance for organizing our European investigations. We visited the FAO plant introduction nursery near Rome, which has been ably managed by Mr. Rossetti. These plantings consisted of trial plots from seeds collected in the Mediterranean Region by Neal-Smith, Kukuck, and others during recent years. They contained many interesting ecotypes of xerophytic character, some of which have never been considered of importance in this country. Test plots of many of these plants had already been established in other European countries and we observed them again in Spain, France, and Germany.

Among the well known forage genera, outstanding responses were observed in the Festuca, Lolium, Dactylis, Phalaris (annuals), Bromus, Trifolium, Lotus, and Medicago. The more indigenous Mediterranean forage species were represented by collections of Hedysarum coronarium and

H. carnosum from Sicily and southern Italy, Plantago albicans from northern Africa and Anthyllis tetraphylla from Portugal.

For trial observations they should be of interest to forage people in our Southwest, including California. With this in mind and as sources of genes for our plant breeders, arrangements were made for securing representative seed lots and tillers.

The Stazoine Agraria Sperimentali at Bari in southern Italy was visited in the latter part of May. There was no active forage breeding at this Station, but arrangements were made for seed exchanges. Some old upland pastures in the area were visited and seed secured.

In northern Italy the stations visited included those at Bologna, primarily concerned with seed multiplication, the horticultural station at Firenzi (Florence), and Stazione Sperimentale di Praticoltura at Lodi. Dr. G. Haussman, one of the leading forage breeders in Italy, is in charge of the latter and showed us the forage work underway at Lodi and a hundred year old pasture in the vicinity. Exchange arrangements for research materials were made with him.

The outstanding new forage development in Italy appears to be in selections of Trifolium squarrosum, made by Prof. Favilli of the College of Agriculture at Pisa. Working with collections of wild native populations from the Apennines, Favilli has made two mass selections designated as A and B. Trifolium squarrosum is a leafy, quick-growing, winter-spring annual, which under favorable culture produces stands similar to alfalfa. It can be cut several times, is reported to seed well, and requires less moisture than our commercial strains of clovers and alfalfas. Small lots of these varieties were obtained for testing along with a local strain of

Trifolium resupinatum, reported to have considerably more cold resistance than its Egyptian progenitor and currently gaining favor as a summer hay crop in Germany.

Spain

Experimental forage research in Spain may be described as being on an incipient level. However, such men as Ing. Ricardo Calvet of the Ministry of Agriculture at the Institucion Nacional de Investigacions Agronomicas in Madrid and Ing. Hycka at the Estacion Esperimentale de Aula Dei near Zaragosa, are aware of its value and are seeking to develop forage resources. Most of Spain is distinctly semi-arid with large areas of badly deteriorated pastures and eroded lands. Re-grassing here is essentially the same tremendous problem as exists in all of vast semi-arid Eurasia. Under FAO auspices and stimulation Spain is conducting tests of forage introduction from both foreign and indigenous collections. Breeding work is apparently limited to simple selections from trial materials, as no genetic breeding work was observed at their stations.

The unusually heavy rains in Spain during the spring had brought a good growth response in their dry-farmed land test plantings at Madrid and we noted good growth in the following:

Phalaris tuberosa
Agropyron desertorum
Bromus inermis
Cossack alfalfa
Trifolium hirtum
Agropyron intermedium
Lolium rigidum
Bromus stramineus
Nomad alfalfa
Smooth hairy vetch

Switzerland

Forage breeding work in Switzerland is mainly done at a few experiment stations in western part of the country and in the vicinity of Zurich in the

northern part. Dr. J. Caputa at the Chateau de Changins near Nyon is in charge of forage work in western Switzerland. This is a new station, administrative headquarters for which is the Etablissment d'Essais et de Controle de Semences at Lausanne. There is also a high altitude station at La Freta near Bullet, where selective work on ecotypes is being done. The environment at La Freta is particularly good for the red and white clovers; the latter being very widely distributed, and for Dactylis glomerata. Caputa has assembled a notable collection of the latter from the Alps, among which are some excellent leafy types. As these collections had lived through a historically killing low temperature period during the spring of 1956 the surviving lots were credited as being extremely cold hardy. It was not possible to obtain tillers of this collection, but Dr. Caputa thought he could supply small duplicate lots of seeds from his original collections. He is also making selections in Arrhenatherum elatius. At Nyon selective work by selfing and cross-pollination from clonal stocks of grasses is underway.

Dr. Nousch of the Eidg. Landw. Versuchsanstalt, at Zurich-Oerlikon, is doing genetic breeding with red clovers. He is especially preoccupied with the variety "matten klee", working with collections he has made of local origin. This is a very tall, stemmy red clover to one meter and over in height, characterized by developing only 5 nodes. Representative lots of his materials were offered to us.

France

The forage stations visited in France included several federal and two private firms: (1) The Central government station at Versailles, branch

stations at (2) Rouen, (3) Rennes, (4) Dijon, (5) Montpellier; and the firms of (6) Vilmorin Company at Paris, and (7) Tourneur Freres at Coulomiers.

- The staff at Versailles, under the direction of Professor Mayer, is carrying on a large series of forage breeding experiments. Observed was selective work with Trifolium repens, T. pratense, Onobrychis viciaefolia, Medicago spp., Lolium spp., Dactylis glomerata, Phleum pratense, Bromus spp., Arrhenatherum elatius, Agrostis spp., and others. Dr. Rebischung has been attempting interspecific crosses in Vicia for several years. This is an important forage and legume crop in France. Reports of a new variety of vetch combined with a new culture method initiated by Blandeau, a French seedsman and breeder, apparently refers to "smooth hairy vetch" in combination with oats or barley as a hay crop. Versailles also has a large clonal series of hybrids between Triticum and Agropyron. They also maintain a segment of the FAO Mediterranean test introductions, and a series of OEEC forage tests designed for Europe. In addition to the principal forage legumes and grasses listed above, the forage crops of France also include marrow stem kale, Brassica oleracea, fodder corn, buckwheat, and fodder half sugar beets, the latter becoming more important in the north European countries. Geographic test plots and research to improve these crops is done at Versailles and at the branch stations.

Among the branch stations visited, the following men and their special fields of activity were observed: Monsieur Hedin at Rouen is especially interested in foreign plant introductions and has several north African accessions under observation. At Rennes in western France M. du Crehu is doing intensive selective work in marrow stem kale and the buckwheat,

Fagopyrum esculentum, both of which are used as cattle feed. An extensive duplicate collection of wheat varieties is also maintained at Rennes, which was particularly fortunate this year as the collections at Versailles were killed by the spring freeze while those at Rennes survived. At Dijon, Mr. J. Picard is breeding red clovers primarily for stem rot resistance to increase their life span and permanence of pasture. He has selected a white-flowered race of red clover. At Montpellier, Ing. L. Hugues is primarily concerned with selected clones of Dactylis glomerata, Bromus inermis, and Onobrychis viciaefolia. He is also concerned with the improvement and management of the stony upland pastures. This station as well as the one at Rouen operate in conjunction with the state agricultural college.

E. R. Vitrac of Tourneur Freres at Coulommiers is noted for his development of the Du Puits strain of alfalfa. Although rather stemmy, it is considered one of the outstanding alfalfas for the European region, as we observed it in test plantings from Italy and Spain to central Sweden. According to M. Vitrac, he obtained Du Puits from crosses between two clones of Ormelong strain, which is originally from the Flamand alfalfas of northwestern France. Some closely related varieties of Flamand origin are currently being refined at Versailles and elsewhere. The name Du Puits is that of an old farm at Coulommiers where M. Vitrac selected the variety and near which he still maintains, by vegetative propagation, about 1000 plants from the original clone. A further refinement of Du Puits is to be found in a new variety to be released next year. It contains more leaf in proportion to stem and more protein than Du Puits and is well marked by its bright reddish purple flowers, which according to Vitrac is the basis for naming it Cardinal. He is also doing breeding work with Trifolium pratense

and has developed varieties homozygous for the seed colors of yellow and purple, and has a selected variety of white-flowered red clover. The collection of alfalfa breeding stock of Tourneur Freres is one of the most outstanding observed in Europe, as it represents a very broad generic range which Vitrac considers essential in breeding stock.

Germany

The maintenance of standard varieties and the testing of new ones in Germany is concentrated at Weihenstephan near Freising in Bavaria. Direction of this station is by Dr. Weller, who is retiring next year and will be succeeded by Dr. Sachs, a well known plant breeder. The work of Sachs and his colleagues and the extensive experimental and test plantings were reviewed during June. In addition to a wide range of materials of such standard items as clovers, alfalfas, and grasses, varying from early to late varieties and hay and pasture types, they are testing various introductions of lupins, fodder half sugar beets, potatoes, and miscellaneous introductions from eastern Europe. Sachs is working with polyploid selections of alfalfa. He is working for new varieties by line breeding and backcrossing of timothy and Agrostis alba with large clonal stocks.

As source materials for plant breeding in Germany are concentrated at Weihenstephan, arrangements were made with Sachs for an exchange of breeding materials from all of western Germany.

Belgium and Holland

As with many of the European experiment stations, the principal research station for Belgium has a large new building for laboratories and offices of administrative and research staff. It is located at Lemberge,

about two miles from the older and more famous Melle farm, which is now incorporated with Lemberge. The forage staff includes Mr. De Roo, Mr. Van Bogaert, and Dr. Van Slycken under the direction of Dr. H. Reytens. Intensive breeding work is being carried on with tetraploid Trifoliums, Lolium, Dactylis, Festuca, and others, for lawns, pastures, hay, etc. At Melle there have been developed some excellent varieties and strains. Their increased physical plant and means of research indicate a continuance of high level research.

The principal breeding station of forage plants in Holland is at Wageningen. It is part of an extensive research institution covering all phases of agriculture and is state supported. Dr. F. Wit is heading up the forage breeding program at Wageningen and is doing intensive selective work with Lolium, Dactylis, Trifolium, and others. Some of the local Holland varieties will be made available to us as seed matures and Dr. Wit offered to make collections of some of the wild species. Breeders' stocks here, as elsewhere generally in Europe, are not available for exchange. Wit indicated that seeds of some of the results of his current breeding efforts may be ready for distribution in about two years. The pasture improvement section at Wageningen has an extensive collection of grass introductions for observation and testing. Some of these came through FAO in Rome.

Denmark

Denmark is a highly organized country so far as agriculture is concerned and this is reflected in the make-up of their plant breeding activities. Breeders' rights here are zealously guarded, as they are in other northern European countries. Forage improvement is almost entirely

done by private seed firms and farmers, and are members of a joint organization known as the Danish Seed Growers Association. Testing of new varieties and seed certification is done by the Danish State Seed Testing Station at and near Copenhagen and at provincial stations. Breeders' stocks for scientific exchange are generally not available because of the dominant commercial interests which control them. We found propagating stock of listed varieties only available and these through the Danish Seed Growers Association in Copenhagen. These seed and plant breeding firms are highly competitive with each other and with other world sources of commercial seed. Their products have long been respected in the seed trade.

Dr. Frandsen, one of the principal forage breeders of Denmark, and Dr. Stahl, director of the State Seed Testing Stations were visited at Taastrup. With the latter the varietal testing plots were observed and representative samples of seed were obtained from the Seed Growers Association when such was listed as commercial seed offerings.

Sweden

Plant Breeding work in Sweden is in part subsidized by the state and in part by private enterprise. The Swedish Seed Association is one of the principal recipients of state funds. Their main station is at Svalof in southern Sweden on a large private farm, with a state-paid research staff. Direction of research is under Dr. Erik Akerberg with the forage section led by Dr. G. Julen. He is conducting extensive and intensive experiments with the hardier strains of clovers, alfalfas, Lolium, Dactylis, Phleum, Agrostis, and others. He has assembled some old land races of the Swedish clovers as source materials for breeding and seeds of these will be made

available to us next year.

The seed firm of W. Weibull at Landskrona is to a less extent state-subsidized. In addition to maintaining very active seed production for local markets, they conduct an extensive breeding program for plant improvement and have a highly skilled and specialized staff. They have recently acquired an extensive farm in southern Brazil, which they intend to develop according to local conditions and needs.

At the Swedish Seed Association's branch station near Uppsala we reviewed the forage plantings as maintained by Mr. Bingefors. Arrangements were made for small lots of seed representing old local strains of the red clovers and a representative series of the Medicago sativa x M. falcata complex from the Island of Gotland. Also at Uppsala our contact with Prof. Turesson of the Botanical Genetic Institute yielded some interesting materials in tetraploid red clover, Medicagos, the original pure strain of tetraploid alsike clover, and others. His response to our desire for research materials was an outstanding reciprocation.

In summarizing our impressions of forage research in western Europe a few modern progressions may be noted. The history of exact origins of most of the European forage crop varieties is obscure. Until recently the source materials of plant breeders have consisted of the traditional local varieties or land races. Each country has generally developed or improved varieties from local stocks. This is still largely the case, but many of the breeders, such as the Swedes and the Dutch, are growing more conscious of the need for new gene sources and are seeking to introduce foreign stocks.

It appears likely that the movement for foreign plant introduction, such as sponsored by Whyte of FAO, will grow. Turesson, with his use of Siberian Medicagos and others, has been indirectly a leader in this respect.

Seed production is a real problem with many good varieties of forage crops in northern Europe. Seed does not develop or mature well because of adverse climatic conditions including cool, wet summers and long day lengths. This is especially true in Sweden, where seed production is limited to the southern part. Some of their excellent cold-hardy varieties such as Alpha alfalfa, produce little seed even in the best of years. They are trying to solve this problem by moving seed production to Mediterranean countries such as Greece and Portugal, and developing new varieties which will produce seed under Swedish climatic conditions.

In legume breeding the emphasis appears to be on disease resistance with longer production tenure and the experimental development and use of tetraploids. The tetraploid strains, achieved by colchicine treatments, all show conspicuous growth vigor and 15-20% more bulk yield than the diploids, but in some cases with increased stemminess and decreased disease resistance.

In grass breeding, as for legumes, the primary objective appears to be on developing disease resistance. Other objectives include development of strains that have more rapid seed germination and vigorous seedling growth, increased winter hardiness or ability to withstand heat or drought, good production of high quality seed, high leaf percentage in proportion to stem and rapid regrowth after harvesting either as pasture or cut green feed or for cured forage.

Considerable breeding work is being done with Brassica spp., Beta spp.

and corn primarily to increase forage production, and with Brassicas for oil also.

Much of the breeding work in all Europe with all forage plants is from the standpoint of developing improvements for more or less localized areas. Considerable advancement has been made from this angle.

At the request of the Northwest Nut Growers Association and Oregon Agricultural Experiment Station (Horticultural Department) checking was done in all countries visited to ascertain what work was being done along the lines of testing, breeding, etc. of nuts, especially filberts. This was for the primary purpose of arranging for and getting for use in the United States, particularly in the Pacific Northwest, propagating and breeding stocks that might be of value in improving this crop. Such information, with promises for sending materials to the United States, were secured and arranged for in Spain, Holland and Sweden. Certain information in this regard was also secured about France but no personal contacts were made in that country.

In addition to such old techniques as single and mass selections, rogueing, etc., the European breeders are making common use of more modern genetic techniques. Some of these include gene spreading by open cross pollination of large or heterogeneous populations with selection and crossing of subsequent generation variants, line breeding and back-crossing, selfing and other controlled forms of pollination, chromosome doubling by colchicine treatments, interspecific crosses via chromosome doubling, etc.

In general there is a fair and open exchange of scientific ideas and information, but not of materials. The prevailing breeders' rights are based on rather solid economic factors.

Field Collections

In the interests of the proposal of the Northeastern Regional Technical Committee limited regions of the Apennines, Pyrenees, and Alps Mountains were given a preliminary exploration, in Italy, Spain, Switzerland, and Bavaria respectively. The remainder of the area through central and northern Europe has very little land that is not occupied by crops. The natural wild plant populations have long been decimated or eliminated. Relic populations are limited to waysides, forest margins, and old pasture lands on stony or marshy sites. The spontaneous plants to be found in such habitats are frequently only escapes from cultivation. Notable exceptions exist, however, as in the case of Phalaris arundinacea and Lotus uliginosus.

The field collections of spontaneous plants are summarized in Table 1. The red and white clovers constitute the majority of the Trifolium accessions, and Medicago falcata led the numbers of collected Medicagos. A few of these collections were represented by living plants, some of which failed to survive transport. Among these was, most regretably, a wild rhizomatous Medicago sativa from the northern Apennines. The miscellaneous collections include a wide range of materials from acorns and ornamentals to various legume and grass genera.

The cultivates collected are not listed, as most of them represent materials obtained from experiment stations. Many of our requests from these institutions will not be received until a later date or season.

Table 1 Collections of Non-cultivates

Trifolium	89	Festuca	59
Medicago	26	Poa	15
Lotus	32	Dactylis	21
Vicia	17	Avena	15
Arrhenatherum	22	Bromus	19
Phalaris	17	Phleum	4
		Miscellaneous	71

Total 407

The Apennines

The Apennines of Italy constitute a valuable hunting area for legume species. The flora is rich in species. Both Medicago and Trifolium are represented by rather numerous species and ecotypes. Land occupancy is incomplete and apparently has long been so. Overgrazing is not severe in the north. The higher and more moist soils of the north have ecotypes at least partly preconditioned to the climates of the temperate United States. The drier south is typically Mediterranean and has quite a different flora. That indicates a wide range of gene availability throughout the Apennines in many genera. Modern plant breeders have apparently made but little use of these latent assets. The recent development of Trifolium squarrosum from original Appennine stocks indicates what may be done by further field and breeding investigations.

The Pyrenees

The Pyrenees of northern Spain are not as rich in economic forage genera as are the Apennines and the Alps. The soils are generally poorer, the climate more arid, and over-grazing is more prevalent. Much of the mountain slope area is composed of coarse atrital materials or weathering rock of igneous and sedimentary origins. There is relatively little grassland environment below the alpine meadows. Many of the species and ecotypes, however, are distinct and should be of interest as new gene sources in developing new varieties where such problems as drought resistance and partial palatability are important, as in much of our West. Very little use appears to have ever been made of these sources in the development of European forage varieties.

Notable among grasses is the occurrence of a fine-leaved, drought-resistant ecotype or ecospecies of Agropyron cristatum affinity, which appears native to the lower, drier, sedimentary slopes of Aragon Province. A truely rhizomatous Medicago sativa of variable character is common in the same region. Native populations of both red and white clovers exist through the Pyrenees. Although inferior as forage types, they may contain genes of value to the plant breeder. Central and southern Spain contain a wide range of variable populations in Trifolium hirtum and T. subterraneum.

Our samplings of the Pyrenees were limited to the eastern end of the cordillera.

The Alps

Switzerland has a cool moist climate and where not forested has fertile crop lands and good pastures. Grassland has doubtless replaced much of the original by cleared woodlands. As the Swiss are industrious, and conservative, the land is quite completely and well utilized. Soils are generally deep, even on steep slopes. In the valleys peat bogs and peaty meadows are common especially at higher elevations. Perhaps nowhere can a more complete range of allies of our common forage varieties be found. These exist as spontaneous populations, either of recent or of prehistoric ecesis. Apparently, the Alps have contributed progenitors to many central European crop varieties, such as red clover, white clover, Dactylis glomerata, Arrhenatherum elatius, Lolium perenne, Agrostis alba, Festuca rubra, Festuca ovina, Avena flavescens, and others.

Throughout the medium elevations, especially in the west, there exist what are referred to as "natural pastures" by Caputa and others. If one

understands that by "natural" is meant pastures which have never been known to be seeded, then the term is useful. The following list of the principal components of one of these natural pastures was obtained on a mountain slope near Le Pont in western Switzerland. It is cut annually for hay by the owner.

Dactylis glomerata	Anthoxanthum odoratum
Poa sp.	Phleum pratense
Avena flavescens	Bromus sp.
Avena cf. bromoides	Trifolium pratense
Cynosurus sp.	Trifolium repens

Such associations together with others from meadows, waysides, and forest margins through high and low elevations of the Alps area aggregate a considerable field for plant exploration.

Altogether about two weeks were spent in making 200 field collections through low to high elevations of Switzerland and Bavaria during the middle and latter part of August. The season, however, was late and the cold wet weather prevailing was not conduc ive to good seed setting. There was very little maturation in the high elevations.

Conclusions and Recommendations

The countries traversed during the summer comprise the larger part of the area indicated in the Northeastern Regional (NE-9) proposal. Most of the important research institutions of Europe were contacted, their work and materials reviewed, and arrangements made for available research materials. A field survey of wild forage populations was made in densely populated areas on a sketchy basis and more carefully in the mountainous regions. Quite extensive field collections were made in the Apennines, Pyrenees, and Alps systems.

The materials requested from northern Europe may be considered as accounted for by current and promised exchanges, except for the two specific items of Lotus uliginosus and Phalaris arundinacea. Due to the unusually late, cool, and wet summer there was very little mature seed development in the former species and poor pollination and ergot seriously affected the latter. Arrangements for seeds of these species were made in some areas for next year. Mr. Kai Larsen, of the Botanical Institute in Copenhagen, should be very helpful in this respect as he is actively engaged in making a cyto-taxonomic monograph of the Eurasian Lotus. Perhaps a field excursion to northern Europe specifically for Lotus uliginosus could be arranged together with Mr. Larsen.

Except for our preliminary work in the Apennines, southeastern Europe remains unexplored for the specific interests of our Northeast. Considering this and the foregoing account, the following suggestions for continuance are offered.

Future efforts should be circumscribed around the Adriatic Sea, through the mountain areas of northern Greece, Yugoslavia, the Austrian Alps, and the Apennines of Italy. There is undoubtedly a large range of forage variants in these regions which have yet to be tested and sifted by the worlds forage breeders. These would include the specific requests of the Northeastern Region, excepting Lotus uliginosus.

It would be of general advantage to plan this exploration in cooperation with R. O. Whyte of FAO in Rome, who has been active in promoting plant exploration throughout the Mediterranean Region. It may be possible and advisable to make this trip as a joint FAO - USDA expedition with

professional personnel of FAO participating. This is, of course, a suggestion as of this date, dependent upon FAO interests and our own. Whether or not such an arrangement develops, Whyte's contacts through Greece and Yugoslavia would be of value to any future party engaged in plant exploration in the area.

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